

What is claimed is:

1. An image forming apparatus, comprising:

an image carrier which is capable of carrying an electrostatic latent image;

a developer in which toner is housed and which transports said toner toward a surface of said image carrier;

image forming means which applies a predetermined developing bias to said developer, to thereby move said toner to said image carrier, visualize said electrostatic latent image formed on the surface of said image carrier with said toner, and consequently forms a toner image; and

memory means which stores toner state information which expresses a state of said toner housed within said developer, wherein

said toner state information is updated in accordance with an operating state of said apparatus and stored; and

a toner image is formed as a patch image when said toner state information satisfies a predetermined control start condition, an image forming condition which influences an image density is optimized based on a toner density of said patch image, and an image density is consequently controlled.

2. The image forming apparatus of claim 1, wherein

said image forming condition is set such that the toner density of said patch image will approximately match with a predetermined density

target value, thereby optimizing said image forming condition; and

said density target value is changed depending on said toner state information.

3. The image forming apparatus of claim 2, wherein optimization of said image forming condition is executed when said density target value is changed, and said image forming condition is set such that the toner density of said patch image will approximately match with thus changed density target value.

4. The image forming apparatus of claim 1, wherein a plurality of image forming conditions are set in relation to said toner state information; and

when a rate of a change of an image density to a change of said toner state information is large, said plurality of image forming conditions are set so that optimization of said image forming conditions will be executed more frequently than where said rate is smaller.

5. The image forming apparatus of claim 1, further comprising exposure means which makes a light beam expose on the surface of said image carrier which is electrified to a predetermined surface potential, to thereby form an electrostatic latent image on the surface of said image carrier, wherein

used as said toner state information are a dot count, which is the

number of dots formed on the surface of said image carrier by the exposure with said light beam, and an operating time of said developer; and

said control start condition is that at least one of said dot count and said operating time reaches a predetermined threshold value.

6. The image forming apparatus of claim 5, wherein

said developer comprises a toner carrier which rotates in a predetermined direction while carrying toner on a surface of said toner carrier to thereby transport said toner to an opposed position facing said image carrier; and

a rotating time of said toner carrier is used as said operating time of said developer.

7. The image forming apparatus of claim 1, wherein

target value correlation information is set in advance which associates density target values with the respective pieces of said toner state information; and

said control start condition is that said toner state information corresponding to an operating state of said apparatus reaches said predetermined threshold value and a predetermined variation is met by or surpassed by a difference between a density target value as it is when said toner state information has just reached said threshold value and a density target value as it was before said toner state information reached said threshold value.

8. The image forming apparatus of claim 7, wherein even though said toner state information corresponding to the operating state of said apparatus has reached said predetermined threshold value, when said predetermined variation is yet to be surpassed by said difference between said density target value as it is when said toner state information has just reached said threshold value and said density target value as it was before said toner state information reached said threshold value, optimization of said image forming conditions is not executed.

9. The image forming apparatus of claim 8, wherein said variation is an optical density of 0.03 or smaller.

10. The image forming apparatus of claim 7, wherein  
said apparatus forms a color image using a plurality of mutually different colors of toner, and forms a monochrome image using black color toner of said plurality of colors; and

said target value correlation information on said black color is different from said target value correlation information on other than said black color.

11. The image forming apparatus of claim 7, wherein  
said apparatus forms a color image using a plurality of mutually different colors of toner;

said target value correlation information is set in advance on a reference color which is one color among said plurality of colors which is consumed the fastest; and

said target value correlation information on the other colors matches with said target value correlation information on said reference color.

12. The image forming apparatus of claim 1, wherein said control start condition is changed in accordance with an initial state of said toner which is housed within said developer.

13. The image forming apparatus of claim 1, further comprising a main body, wherein said developer comprises a memory element which can be freely attached to and detached from said main body and which functions as at least a portion of said memory means.

14. An image forming method in which an electrostatic latent image is formed on a surface of an image carrier, a predetermined developing bias is applied to a developer which houses toner, said toner accordingly moves toward said image carrier, said electrostatic latent image is visualized with said toner, and a toner image is consequently formed, wherein

toner state information which expresses a state of said toner housed within said developer is updated in accordance with an operating state of

said apparatus; and

when said toner state information satisfies a predetermined control start condition, a toner image is formed as a patch image, an image forming condition which influences an image density is optimized based on a toner density of said patch image, and an image density is consequently controlled.

15. The image forming method of claim 14, wherein

a light beam is made expose on the surface of said image carrier which is electrified to a predetermined surface potential, to thereby form an electrostatic latent image on the surface of said image carrier; and

used as said toner state information are a dot count, which is the number of dots formed on the surface of said image carrier by the exposure with said light beam, and an operating time of said developer, and that said control start condition is that at least one of said dot count and said operating time reaches a predetermined threshold value.

16. An image forming apparatus, comprising:

a main body;

a process cartridge which can be freely attached to and detached from said main body; and

control means which forms a toner image as a patch image using said process cartridge which is attached to said main body, detects a density of said patch image, and executes a condition controlling process

which is for controlling of an image forming condition based on a result of the detection, wherein

when said process cartridge attached to said main body is removed from said main body and thereafter again attached to said main body, said control means determines whether thus attached process cartridge is the same as the process cartridge removed earlier, and when determining that the two are not the same, said control means executes said condition controlling process, but when determining that the two are the same, said control means does not execute said condition controlling process.

17. The image forming apparatus of claim 16, wherein  
said process cartridge comprises record means which records identification information which is for distinguishing a process cartridge which is attached to said main body from other process cartridges; and  
said control means makes said judgment based on said identification information which is recorded in said record means of said process cartridge.

18. The image forming apparatus of claim 17, wherein in at least one of said process cartridges, disposed as said record means is a memory part in which information indicative of a state of use of this process cartridge is stored, and at least a portion of information stored in said memory part is used as said identification information.

19. The image forming apparatus of claim 18, wherein

when said process cartridge comprising said memory part is to be removed from said main body, prior to the removal, said control means makes said memory part of said process cartridge store the information indicative of a state of use of this process cartridge; and

upon attachment of said process cartridge comprising said memory part to said main body, when said identification information stored in said memory part of the attached process cartridge matches with said identification information stored in said memory part of the process cartridge which was removed prior to the attachment, said control means determines that these process cartridges are the same, but when these pieces of information fail to match with each other, said control means determines that these process cartridges are not the same.

20. The image forming apparatus of claim 18, wherein

said process cartridge comprising said memory part is a developer which houses toner; and

in said developer, information indicative of a state of use of said toner within said developer is stored in said memory part.

21. The image forming apparatus of claim 16, wherein

a plurality of developers which house mutually different colors of toner can be attached to and detached from said main body as said process cartridge; and



when said control means determines, as said judgment which is made at the time that any one of said plurality of developers is attached to said main body, that there is a developer which is not the same, said control means executes said condition controlling process only on a toner color which corresponds to this developer which has just been determined not to be the same among said plurality of toner colors.

22. The image forming apparatus of claim 17, wherein within at least one of said process cartridges, information indicative of whether this process cartridge is a new cartridge is recorded in said record means as said identification information.

23. The image forming apparatus of claim 16, further comprising clock means which measures an elapsed time since execution of said condition controlling process, wherein

when said process cartridge is attached after said elapsed time exceeded a predetermined period of time, said condition controlling process is executed regardless of said judgment.

24. An image forming apparatus, comprising:

a main body;

a process cartridge which can be freely attached to and detached from said main body; and

control means which forms a toner image as a patch image using

said process cartridge which is attached to said main body, detects a density of said patch image, and executes a condition controlling process which is for controlling of an image forming condition based on a result of the detection, wherein

when said process cartridge is attached to said main body, said control means makes a judgment regarding whether thus attached process cartridge is the same as a process cartridge which used to be attached to said main body before execution of said condition controlling process which took place prior to the attachment, and when determining that the two are not the same, said control means executes said condition controlling process, but when determining that the two are the same, said control means does not execute said condition controlling process.

25. The image forming apparatus of claim 24, wherein

said process cartridge comprises record means which records identification information which is for distinguishing a process cartridge which is attached to said main body from other process cartridges; and

said control means makes said judgment based on said identification information which is recorded in said record means of said process cartridge.

26. The image forming apparatus of claim 25, wherein in at least one of said process cartridges, disposed as said record means is a memory part in which information indicative of a state of use of this

process cartridge is stored, and at least a portion of information stored in said memory part is used as said identification information.

27. The image forming apparatus of claim 26, wherein

when said process cartridge comprising said memory part is to be removed from said main body, prior to the removal, said control means makes said memory part of said process cartridge store the information indicative of a state of use of this process cartridge; and

upon attachment of said process cartridge comprising said memory part to said main body, when said identification information stored in said memory part of the attached process cartridge matches with said identification information stored in said memory part of the process cartridge which was removed prior to the attachment, said control means determines that these process cartridges are the same, but when these pieces of information fail to match with each other, said control means determines that these process cartridges are not the same.

28. The image forming apparatus of claim 26, wherein

said process cartridge comprising said memory part is a developer which houses toner; and

in said developer, information indicative of a state of use of said toner within said developer is stored in said memory part.

29. The image forming apparatus of claim 24, wherein

a plurality of developers which house mutually different colors of toner can be attached to and detached from said main body as said process cartridge; and

when said control means determines, as said judgment which is made at the time that any one of said plurality of developers is attached to said main body, that there is a developer which is not the same, said control means executes said condition controlling process only on a toner color which corresponds to this developer which has just been determined not to be the same among said plurality of toner colors.

30. The image forming apparatus of claim 25, wherein within at least one of said process cartridges, information indicative of whether this process cartridge is a new cartridge is recorded in said record means as said identification information.

31. The image forming apparatus of claim 24, further comprising clock means which measures an elapsed time since execution of said condition controlling process, wherein

when said process cartridge is attached after said elapsed time exceeded a predetermined period of time, said condition controlling process is executed regardless of said judgment.

32. An image forming method in which a process cartridge for image formation can be freely attached to and detached from a main body

of an apparatus, a toner image is formed as a patch image using said process cartridge which is attached to said main body, a density of said patch image is detected, and a condition controlling process which is for controlling of an image forming condition is executed based on a result of the detection, wherein

when said process cartridge attached to said main body is removed from said main body and thereafter again attached to said main body, whether thus attached process cartridge is the same as the process cartridge removed earlier is determined, and said condition controlling process is executed when it is determined that the two are not the same, but said condition controlling process is not executed when it is determined that the two are the same.

33. An image forming method in which a process cartridge for image formation can be freely attached to and detached from a main body of an apparatus, a toner image is formed as a patch image using said process cartridge which is attached to said main body, a density of said patch image is detected, and a condition controlling process which is for controlling of an image forming condition is executed based on a result of the detection, wherein

when said process cartridge is attached to said main body, a judgment is made regarding whether thus attached process cartridge is the same as a process cartridge which used to be attached to said main body before execution of said condition controlling process which took place

prior to the attachment, and when it is determined that the two are not the same, said condition controlling process is executed, but when it is determined that the two are the same, said condition controlling process is not executed.

34. An image forming apparatus, comprising:

a main body;

a plurality of developers which can each be freely attached to and detached from said main body; and

control means which forms toner images as patch images using said developers which are attached to said main body, and executes a condition controlling process, which is for controlling of an image forming condition for formation of toner images using said developers, based on a detection result on densities of said patch images, wherein

on each one of said developers which are attached to said main body, said control means determines whether it is necessary to execute said condition controlling process on each developer based on information indicative of a state of use of said each developer, and when determining that said condition controlling process needs be executed on at least one developer, said control means executes said condition controlling process on the developer which has just been determined to require said condition controlling process, but does not execute said condition controlling process on the other developers.

35. The image forming apparatus of claim 34, further comprising memory means which stores said information.

36. The image forming apparatus of claim 34, wherein each developer comprises a memory part which stores information indicative of a state of use of this developer.

37. The image forming apparatus of claim 34, wherein on at least one of said developers which are attached to said main body, when said information indicative of a state of use of this developer satisfies a predetermined control start condition which has been set in advance for this developer, said control means determines that it is necessary to execute said condition controlling process on this developer.

38. The image forming apparatus of claim 34, wherein said information includes toner state information which is indicative of a state of use of toner which is housed within said developers which are attached to said main body.

39. An image forming apparatus, comprising:  
a main body;  
a plurality of developers which can each be freely attached to and detached from said main body; and  
control means which forms toner images as patch images using

said developers which are attached to said main body, and executes a condition controlling process, which is for controlling of an image forming condition for formation of toner images using said developers, based on a detection result on densities of said patch images, wherein

when at least one developer was removed from said main body and a new developer has been attached to said main body, said control means executes said condition controlling process on the attached developer but does not execute said condition controlling process on the other developers which have been remaining attached to said main body since before the attachment.

40. A control method for an image forming apparatus in which a plurality of developers can each be freely attached to and detached from a main body of an apparatus, wherein

toner images are formed as patch images using said developers which are attached to said main body, and a condition controlling process, which is for controlling of an image forming condition for formation of toner images using said developers, is executed based on a detection result on densities of said patch images; and

on each one of said developers which are attached to said main body, whether it is necessary to execute said condition controlling process on each developer is determined based on information indicative of a state of use of each developer, and when it is determined that it is necessary to execute said condition controlling process on at least one developer, said



condition controlling process is executed on the developer which has just been determined to require said condition controlling process, but said condition controlling process is executed on the other developers.

41. A control method for an image forming apparatus in which a plurality of developers can each be freely attached to and detached from a main body of an apparatus, wherein

toner images are formed as patch images using said developers which are attached to said main body, and a condition controlling process, which is for controlling of an image forming condition for formation of toner images using said developers, is executed based on a detection result on densities of said patch images; and

when at least one developer was removed from said main body and a new developer has been attached to said main body, said condition controlling process is executed on the attached developer but not on the other developers which have been remaining attached to said main body since before the attachment.

42. An image forming apparatus, comprising:

an image carrier which is capable of carrying an electrostatic latent image;

a developer in which toner is housed and which transports said toner toward a surface of said image carrier;

image forming means which applies a predetermined developing

bias to said developer, to thereby move said toner to said image carrier, visualizes said electrostatic latent image formed on the surface of said image carrier with said toner, and consequently forms a toner image; and

density detecting means which detects a toner density of a toner image which is formed as a patch image, wherein

a density target value of said patch image is changed in accordance with an operating state of said apparatus; and

an image forming condition which influences an image density is optimized based on said density target value and the toner density of said patch image detected by said density detecting means, whereby an image density is controlled.

43. The image forming apparatus of claim 42, wherein said density target value is set in accordance with characteristics of said toner which is housed in said developer.

44. The image forming apparatus of claim 43, wherein said density target value is set in accordance with a combination of primary toner information, which is indicative of toner characteristics as they are at the time of introduction of said toner into said developer, and secondary toner information which is indicative of a state of use of said toner corresponding to an operating state of said apparatus.

45. The image forming apparatus of claim 44, wherein said

secondary toner information includes information regarding a remaining toner amount of said toner within said developer.

46. The image forming apparatus of claim 45, further comprising exposure means which makes a light beam expose on the surface of said image carrier which is electrified to a predetermined surface potential, to thereby form an electrostatic latent image on the surface of said image carrier, wherein

said remaining toner amount is calculated based on the number of dots formed by said exposure means.

47. The image forming apparatus of claim 44, wherein

said developer comprises a toner carrier which rotates in a predetermined direction while carrying toner on a surface of said toner carrier to thereby transport said toner to an opposed position facing said image carrier; and

said secondary toner information includes information regarding the number of revolutions of said toner carrier.

48. The image forming apparatus of claim 44, wherein said developer comprises memory means which stores at least one of these pieces of information.

49. The image forming apparatus of claim 42, wherein said

density target value is increased or decreased in accordance with a density change request made by a user.

50. An image forming method in which an electrostatic latent image is formed on a surface of an image carrier, a predetermined developing bias is applied to a developer which houses toner, said toner accordingly moves toward said image carrier, said electrostatic latent image is visualized with said toner, and a toner image is consequently formed, wherein

a density target value is changed in accordance with an operating state of an apparatus, a toner density of a toner image formed as a patch image is detected, and an image forming condition which influences an image density is optimized based on a result of the detection and said density target value, whereby an image density is controlled.

51. The image forming method of claim 43, wherein said density target value is set in accordance with a combination of primary toner information, which is indicative of toner characteristics as they are at the time of introduction of said toner into said developer, and secondary toner information which is indicative of a state of use of said toner corresponding to an operating state of said apparatus.